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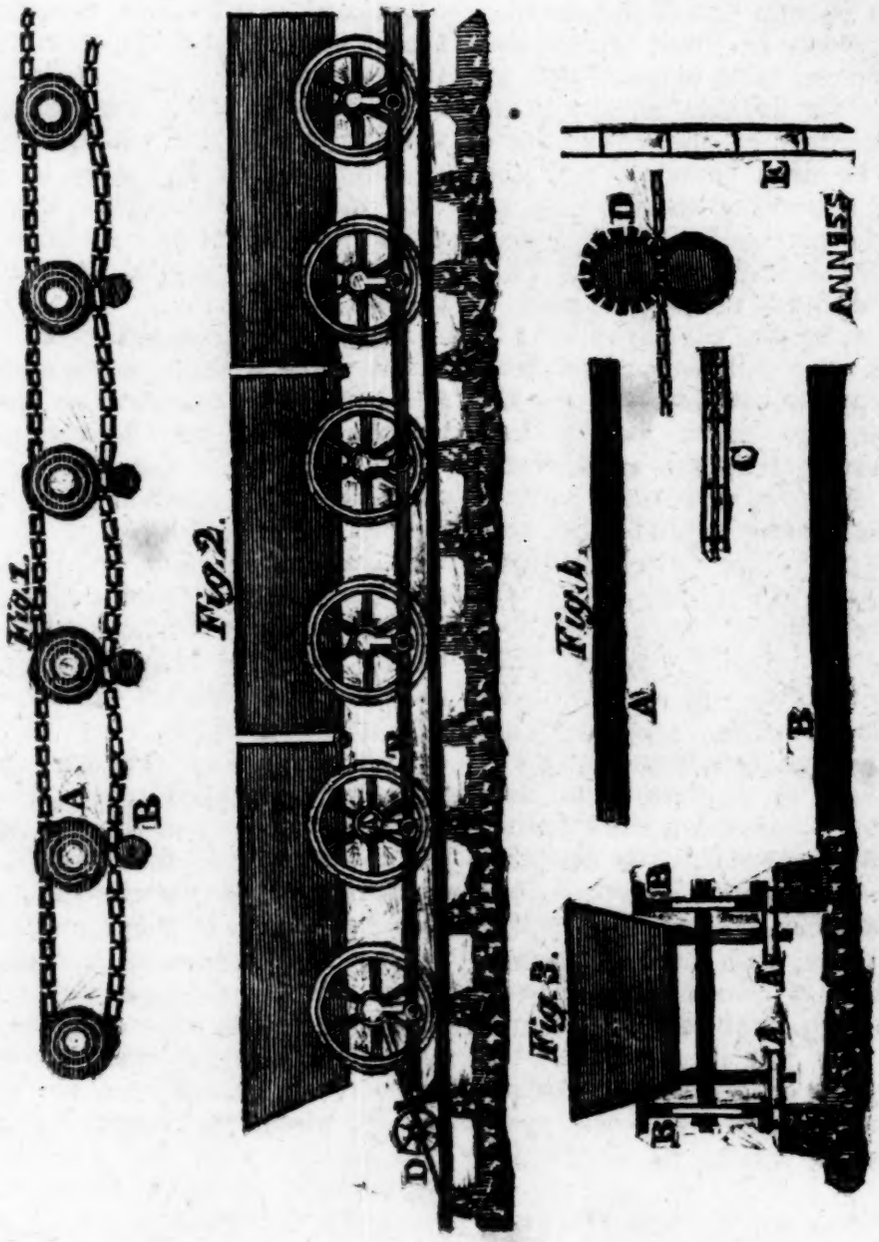
Come, bright improvement! on the car of Time,
And rule the spacious world from clime to clime:
Thy handmaid Arts shall every wild explore,
Trace every wave, and culture every shore.—*Campbell.*

Description of some improvements in the construction of Railways, and in the mode of propelling carriages upon them.—BY E. CLARK.



IMPROVEMENT IN THE CONSTRUCTION OF RAILWAYS.

Examining the plan of propelling steam carriages on railways by the application of toothed wheels to continuous rack work, the *pou sto* of the contrivance appears awkward, and its success equivocal. It possibly may answer, if guarded from the weather, and secured against the interference of accident or design, either of which might be productive of disastrous results to carriages moving with considerable velocity over railways. But in what way could the rack be used in the United States, or even in Great Britain, subject as it would be, from the character of climate, to be clogged with ice and snow for several months in the year? Besides, as the resistance of friction of iron moving on iron, amounts, according to the very satisfactory experiments of Coulomb, (see Journal de Physique, Vol. XXVII. pp. 206 and 282) to 25 per cent. of the weight, loaded carriages may be propelled over railways more devious in their inclinations from the horizon than our roads usually are, without having recourse to the tooth wheel and rack, and also without their wheels being liable to slip, provided the propelling power be distributed so as to act equally at all the points of resistance. Such a distribution may be effected, by adapting drums to the axles of the carriages, and passing flexible bands from one to another, so as to embrace them all; or by passing an endless chain over the teeth of toothed wheels substituted for these drums, or by adapting a series of toothed wheels to the axles or wheels, and others intermediate to them, with their teeth constructed to play into each other so as to extend the power at pleasure from the axle first put in motion by the steam engine; or, lastly, by attaching cranks to the axles and continuing the power as above, by connecting rods.

But in these applications, the axles made fast to the wheels, should rotate in pivot boxes secured in the carriage supports, though a different arrangement may be made, which shall embrace the motion of the wheels on their axles. It will be expedient to connect the carriage together by universal joints, to allow a slight curvature in the line of carriages, when the deviations of the railways from a right line require it.

The snow and ice which would encumber the rack-work, as before noticed, will also impede the progress of carriages by collecting on the railways; other substances may also be collected on them, either by accident or design.

To obviate this inconvenience, as far as is practicable, it will be found expedient to attach a messenger to the forward axle of the carriages, for the purpose of clearing the railways. It may also perform the office of governour, where its advance is opposed, or diverted from its course, by objects that may have accumulated on the railways, and would endanger the carriage if permitted to pass over them.

For this purpose, rods connecting it to the valve gearing of the steam engine, and some contrivance for locking the wheels, may be applied.

The flanches of the wheels in common use, must, when in motion, press against the inner edges of the railways, and produce a resistance that may be very considerably diminished, by substituting friction wheels for them, so as to play from vertical axles, appended from the carriages, against these edges.

Should inclinations in the railways, necessarily become so great, that carriages cannot be passed over them by the contrivances before named, ropes or chains may be fastened at the extreme elevation of these inclinations, and be from thence extended downwards over a suitable bridging to the points, at which this difficulty shall cease, where they may be passed either over windlasses or toothed wheels, which are caused to rotate by a connexion with the steam engine movements, in such manner as to draw the carriages up, or, if necessary, lower them down said inclinations.

This application of locomotive steam engines, is intended as a substitute

for the stationary steam engine sproposed to accomplish the same object. The bridging above alluded to is intended for supporting the chain, thus used, above the earth, for the purpose of keeping it clear from incumbrance.

Though not immediately connected with this subject, the application of chains in a similar manner to facilitate the passage of steam boats and other boats, on canals and rivers, and particularly over rapids of rivers, where the current is too great to be overcome by the power of the steam engine, deserves consideration; and probably there is no place in the United States, where it could be so beneficially applied as on the Susquehannah River, between the borough of Columbia and the tide waters below. Here it would prove particularly advantageous to the citizens of Baltimore; because the craft which ordinarily navigate this river, cannot continue their voyage over the waters of the Chesapeake Bay in safety; while steam boats can, and that too, through a natural route much less expensive than any other which can be executed by art.

Explanation of the Drawing.

Fig. 1.

A represents either the drums or toothed wheels which are designed to be placed on the axles for the reception of flexible bands or an endless chain, as shown in this figure.

B, small rollers to prevent the swag of the chain.

Fig. 2.

A line of carriages connected by swivel joints.

A, joinings of the cranks to the axles.

B, rods connecting the cranks together.

D, the messenger, or apparatus designed for clearing the railways for the safe and easy passage of the carriage.

Fig. 3.

End view of a carriage.

AA, rollers or wheels for guiding the carriage wheels, BB, on the railways.

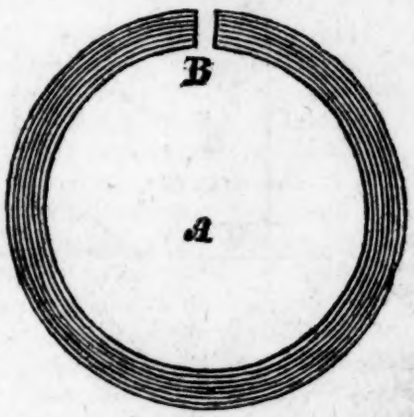
Fig. 4.

AB, sections of a railway, with the bridge C, supporting a chain, intermediate to them.

D, represents a toothed wheel playing into the links of a chain and the groove of a grooved wheel situated beneath it.

E, section of the bridge without the chain.

MOULD FOR MAKING CORES USED IN CASTINGS.



Sir,—In making some kinds of castings it is highly important to secure apertures of uniform calibre through them; but this object is seldom obtained, owing to the difficulty of forming accurate cores. The above diagram represents a mould proposed by Mr. Isaiah Lukens of Philadelphia, by which this difficulty may be effectually obviated. Should you think its publication likely to subserve the interests of the highly useful class of our citizens, who are engaged in the iron and brass foundry business, you will please give it a place in your Magazine.

A Represents the transverse section of a cylinder of wood whose calibre is accurately formed.

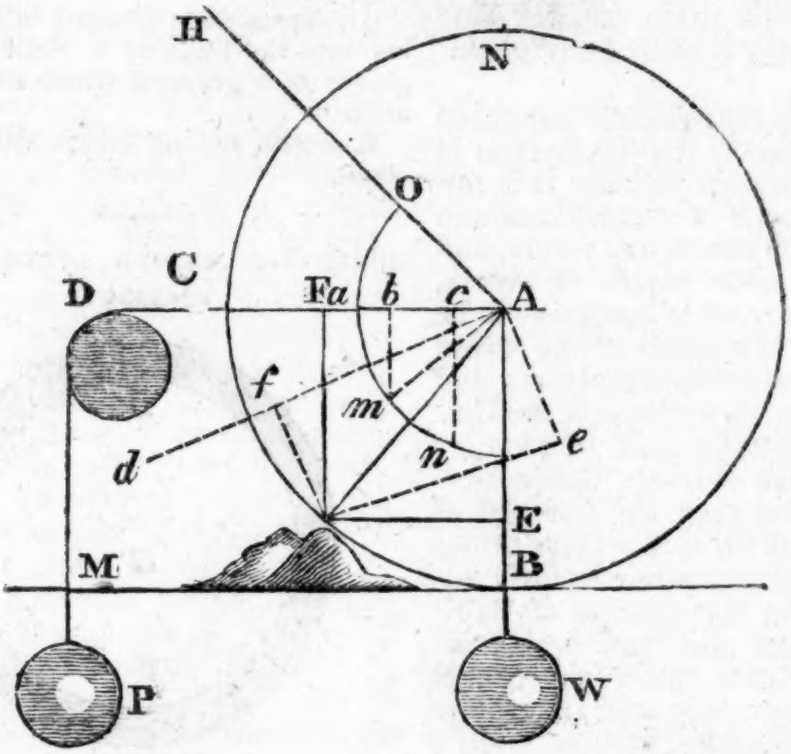
B, A longitudinal incision, quite through the cylinder.

The principle by which this mould is worked, depends on the elasticity of the wood. Previously to forming the core, the incision at B is closed by pressure and the mould is secured with twine; it is next filled with loam or sand, and then the twine being cut, it springs open, and may be readily removed without disturbing the core.

Core Box.

Philadelphia, April 29th.

ON THE SIZE OF CARRIAGE WHEELS.



We publish the following extracts from Dr. Brewster's edition of Ferguson's Lectures, in hopes that it may induce our wheel wrights to conform their works to a more scientific practice than at present prevails among them.—Ed.

The very assistance which theory has furnished to the artist in these cases, has been rendered not only useless, but injurious, by an erroneous application; and we may safely affirm, that there is no species of machinery where less science is displayed than in the construction and position of carriage wheels.

When the wheels of carriages either move upon a level surface, or overcome obstacles which impede their progress, they act as mechanical powers, and may be reduced to levers of the first kind.

To elucidate this remark, let A be the centre, and B C N the circumference of a wheel 6 feet in diameter, and let the impelling power P act in the horizontal direction A D. Then, if the wheel is not affected by friction, it will be put in motion upon the level surface M B, when the power P is infinitely small. For since the whole weight of the wheel rests on the ground at the point B, which is the fulcrum of the lever A B, the distance of the weight from the centre of motion will be nothing, and therefore the mechanical energy of the smallest power P, acting at the point A, with a length of lever A B, will be infinitely great when compared with the resistance of the weight to be raised, and this will be the case however small be the lever A B, however great be the weight of the wheel. But as the wheels of carriages are constantly meeting with impediments, let C be an obstacle 6 inches high, which the wheel is to surmount. Then the spoke A C will represent the lever, C its fulcrum, A D the direction of the power; and if the wheel weighs 100 pounds, we may represent it by a weight W fixed to the wheel's centre A, or to the extremity of the lever C A, and acting in the perpendicular direction A B, in opposition to the power P. Now the mechanical energy of the weight, W, to pull the lever round its fulcrum in the direction A E, is represented by C E, while the mechanical energy of an equal weight P to pull it in the opposite direction A F, is represented by C F; an equilibrium, therefore, will be produced, if the power P is to the weight W as C E to C F, or as the sine is to the cosine of an angle, whose versed sine is equal to the height of the obstacle to be surmounted; for E B, the height of the mound C, is the versed sine of the angle B A C and C E is the sine, and C F the

cosine of the same angle. In the present case, where E B is 6 inches, and A B 3 feet, E B the versed sine will be 166, &c. where A B is 1000; and consequently, the angle B A C will be 33° 33′ and CE will be to E F as 52 to 83, or as 66 to 100. A weight P, therefore, of 66 pounds acting in a horizontal direction, will balance a wheel 6 feet diameter, and 100 pounds in weight, upon an obstacle 6 inches high; and a small additional power will enable it to surmount that obstacle. But if the direction A D of the power be inclined to the horizon, so that the point D may rise towards H, the line F C, which represents the mechanical energy of P, will gradually increase, till A D has reached the position H A, perpendicular to A C, where its mechanical energy, which is scarce a maximum, is represented by A C, the radius of the wheel; and since E C is to C A as 53 to 100, a little more than 53 pounds will be sufficient for enabling the wheel to overcome the obstacle.

Proceeding in this way, it will be found that the power of wheels to surmount eminences increase with their diameter, and is directly proportional to it, where the weight remains the same, and when the direction of the power is perpendicular to the lever which acts against the obstacle. Hence we see the great advantages which are to be derived from large wheels, and the disadvantages which attend small ones.

When the radius AB of the wheel is greater than DM, the height of the pulley or of that part of the horse to which the rope or pole DA is attached, the direction of the power, or the line of traction AD, will be oblique to the horizon A *d*, and the mechanical energy of the power will be only A *e*, whereas, it was represented by AE, when the line of traction was in the horizontal line DA. Whenever the radius of the wheel, therefore, exceeds *four feet and a half*, (or) the height of that part of the horse to which the traces should be attached, the line of traction AD will incline to the horizon, and by declining from the perpendicular AH, its mechanical effort will be diminished; and since the load rests upon an inclined plane, the traces, or poles of the cart will rub against the flanks of the horse, even on level roads, and still more severely on descending ground. Notwithstanding this diminution of force, arising from the unavoidable obliquity of the impelling power, wheels exceeding 4 1-2 feet radius have still the advantage of small ones; but their power to overcome resistances does not increase so fast as before. But when we augment their diameter, we add to their weight, thus increasing the load, and diminishing their power. Another disadvantage of large wheels is to increase the risk of overturning the load, by the elevation of the centre of gravity.*

The advantages of large wheels are particularly great, as Dr. Young has remarked, in soft and boggy soils and in sandy countries, and he finds that the resistance which, in these cases, opposed to the motion of a given wheel may be reduced to one half, either by making the wheel a little less than three times as high, or by making it eight times as broad as the given wheel. Camus, in his *Traité des Forces Mouvantes*, has given an account of a great number of experiments on the superiority of large wheels, under a variety of circumstances. Many other eminent men have held the same opinion upon this point.

From these remarks we see the superiority of great wheels over small ones, and the particular circumstances which suggest the propriety of making the wheels of carriages less than 4 1-2 feet radius.

Even this size is too great, and we may safely assert, that wheels ought never to exceed 6 feet in diameter, and should never be less than 3 1-2 feet. When the nature of the machine will permit, large wheels should always be preferred, and small ones should never be adopted, unless we are compelled to employ them by some unavoidable circumstance in the construction. This maxim, which has been inculcated by every person who has written on the subject, seems to have been strangely neglected by practical mechanics. The fore wheels of our carriages are still unaccountably small. The workmen, indeed, will tell us that the wheels are made small for the conveniency of turning, and for facilitating the loading of the cart; but how trifling are these advantages when compared with that diminution of the horses' power, which necessarily results from the use of small wheels. It has been objected against large fore wheels, that the horses, when going down a declivity, cannot so easily prevent the carriage from running downwards; but this very objection is an acknowledgement that large fore

* This objection may be easily remedied, by suspending the carriages from and below the axles, which would depress the centre of gravity.—Ed.

wheels are advantageous, both in horizontal and inclined planes, otherwise their tendency downwards would not be greater than that of small ones.

THE MOCKING BIRD.

The plumage of the American Mocking Bird, though none of the homeliest, has nothing gaudy or brilliant in it, and had he nothing else to recommend him, would scarce entitle him to notice; but his figure is well proportioned and even handsome. The ease, elegance, and rapidity of his movements, the animation of his eye, and the intelligence he displays, in listening and laying up lessons from almost every species of the feathered creation within his hearing, are really surprising, and mark the peculiarity of his genius. To these qualities we may add that of a voice, full, strong and musical, and capable of almost every modulation, from the clear mellow tones of the Wood Thrush, to the savage scream of the Bald Eagle. In the measure and accents he faithfully follows the originals; in force and sweetness of expression he greatly improves upon them. In his native groves, mounted on a bush, or half-grown tree, in the dawn of every morning, while the woods are already vocal with a multitude of warblers, his admirable song rises pre-eminent over every other competitor. The ear can listen to *his* music alone, to which that of the others seem a mere accompaniament; neither is this strain altogether imitative. His own *native* notes, which are easily distinguished by such as are well acquainted with those of the various song birds, are bold and full, and varied seemingly beyond all limits. They consist of short expressions of two, three, or at the most five or six syllables, generally interspersed with imitations, and all of them uttered with emphasis and rapidity, and continued with undiminished ardour for half an hour at a time. His expanded wings and tail glistening with white, and the buoyant gaiety of his action arresting the eye as his song most irresistibly does the ear, he sweeps round with enthusiastic ecstacy he mounts and descends as his song swells or dies away. Whilst thus exerting himself, a by-stander destitute of sight, would suppose the whole feathered tribe had assembled together on a trial of skill, each striving to produce his utmost effect, so perfect are his imitations. He many times deceives the sportsman, and sends him in search of birds that are perhaps not within miles of him, but whose notes he exactlyimitates; even birds themselves are frequently imposed on by this admirable music, and are decoyed by the fancied calls of their mate or dive with precipitation into the depths of thickets at the scream of what they suppose to be the sparrow hawk. The mocking bird loses little of the power and energy of his song by confinement. In his domesticated state, when he commences his career of song, it is impossible to stand by uninterested. He whistles for the dog, Cæsar starts up, wags his tail, and runs to meet his master. He squeaks out like a hurt chicken, and the hen hurries about with hanging wings and bristled feathers, clucking to protect her injured brood. The barking of a dog, the mewing of the cat, the creaking of a passing wheelbarrow, follow with great truth and rapidity. He repeats the tune taught him by his master, though of considerable length, fully and faithfully. He runs over the quiverings of the Canary, and the clear whistlings of the Virginia nightingale, or red bird, with such superior execution and effect, that the mortified songsters feel their own inferiority, and become altogether silent, while he seems to triumph in their defeat, by redoubling his exertions. This excessive fondness for variety, however, in the opinion of some, injures his song. His elevated imitations of the brown thrush, are frequently interrupted by the crowing of cocks; and the warblings of the blue bird, which he exquisitely manages, are mingled with the screaming of swallows, or cackling of hens; amidst the simple melody of robins, we are suddenly surprised with the shrill reiterations of the whip-poor-will, while the notes of the killdeer, blue jay, martin, and twenty others, succeed with such imposing reality, that we look round for the originals, and discover with astonishment, that the sole performer in this singular concert is the admirable bird now before us. During this exhibition of his powers, he spreads his wings, expands his tail, and throws himself around the cage in all the ecstacy of enthusiasm, seeming not only to sing but to dance, keeping time to the measure of his music. Both in his native and domesticated state, during the *solemn stillness of night*, as soon as the *moon rises in silent majesty*, he begins his *delightful solo*, and serenades us *the live long night*, with a full display of his vocal powers, making the whole neighbourhood ring with his imitative medley.

PADDLE WHEELS.

SIR,—I have lately seen several notices in American and Foreign journals, of small boats having been advantageously propelled through the water by manual labour, applied to paddle wheels, as though the improvement was meritorious and new. As to the merit of the plan I have little to say, though no doubt there are cases, in which the measure might be put in practice to good advantage; boats engaged on long voyages, and carrying a superabundance of men, would be instances to the point; but the wheels are too much in the way for ordinary purposes.

There is nothing new in the application, for Mr. George Campbell of Philadelphia propelled a boat in this manner publicly on the Delaware river ten or twelve years since; hence, whatever the merit of the contrivance may be, it is justly his due, unless claims prior to his can be substantiated.

A WITNESS.

Philadelphia, April, 30th.

BRITISH LACE TRADE.

There is nothing more cheering to contemplate than the various improvements and discoveries which are daily taking place throughout the British empire, and as constantly adding to its unexampled commercial prosperity, and extending its gigantic resources. Among the many novelties of the day, a most important one, as regards the British lace trade, is, at this moment, exciting a strong sensation in the minds of all who are interested in this branch of manufacture, and bids fair to give a great additional impulse to the consumption of the beautiful article which forms its object. For this discovery the public is indebted to the genius of Sir Robert Peel. A small lace manufactory has recently been established at Tamworth, by the Messrs. Willcox, and was, a short time since, honoured by a visit of inspection from the worthy Bart. His powerful and sagacious mind instantly suggested the idea of printing on the lace, and the experiment instituted under the direction of that excellent practical chemist, Mr. Alsop, of the Bonehill works, has answered the most sanguine expectations. Some exquisitely beautiful specimens of lace dresses, printed in fast colours, were, last week, exhibited in Nottingham, from the house of Edmund Peel and Co., and excited great interest and admiration. The necessary steps have already, it is said, been taken to secure, by patent, to the company, the exclusive advantages of this novel and elegant invention. Differing, as we do, from Sir Robert Peel, on many points of political conduct and opinion, yet cannot we suffer to pass, unimproved, the present opportunity of offering our feeble eulogy to the character of that extraordinary man, who, after having, by a life of successful enterprise and exertion, raised to a proud elevation the fortunes of his family, and incalculably extended the commerce and resources of his country, deems it no degradation to descend from the splendid retirement of his later age, and suggest to others, less gifted and less experienced than himself, improvements, which, while productive of great national benefit, may contribute to achieve for his own reputation, honours more bright and permanent than wealth can purchase, or all the vaunted pride of ancestry confer.

Litchfield Mercury.

THE CONSERVATORY OF ARTS.

The public and gratuitous lectures of this admirable and useful establishment have been resumed this year, under the happiest auspices of increased success. M. Dupin has been appointed Professor of Mechanics applied to the arts; M. Clement Desormes, of Chemistry and Physics applied to the Arts; and M. Say, of Industrial Economy, or of the principles of Political Economy applied to the useful Arts. Two ameliorations have taken place in these courses of lectures, very favourable to the national prosperity, The lectures are delivered at half-past eight o'clock in the evening, when the classes of artisans and working mechanics have completed the labours of the day, and consequently are at leisure to attend to the acquirement of knowledge without injury to their interests, and the Professors distribute a lecture in advance, a bulletin of the matters to be treated in the next. M. Dupin, following the example of English Professors who prepare before the commencement a brief analysis of the subjects to be treated in each lecture, is writing a treatise of practical geometry and mechanics, adapted to the comprehension of artisans. This instruction is not, however, offered altogether gratuitously to those who wish to avail themselves of it, two sous being required for each bulletin. This very small contribution is sufficient to obtain a moral result of great importance; they put more value on a paper

which is thus acquired, preserve it with greater care, and are more anxious to impress its contents on their understanding.

Rev. Enc.

PORTABLE FIRE ENGINES.

The *Scotsman* says, "We have had an opportunity of taking a hasty glance at some documents which the committee of General Commissioners of Police have obtained through the Chevalier Masclet, Consul for France. They relate to the Parisian system of extinguishing fires; and as far as we can judge, nothing can be better arranged, or more completely adapted to the end in view. We think our readers will join with us in opinion when we mention, that although the number of fires in Paris be extremely large, (being 788 in the year 1823, and averaging 540 in the 19 previous years) yet such is the dexterity of the corps of Sappeurs Pompiers, that the whole annual amount of loss by fire is estimated at one part in 23,000, so that the number of houses in Paris being about 26,000, there is less than one house annually destroyed out of 788 which take fire. We were present also at the trial of a portable fire engine, made here under the direction of one of our fellow-citizens. We were much gratified in observing its simplicity and its great power, and not a little struck in perceiving its close conformity in all essential points with the engines described in the French documents, while we know that it had been *completed and tried* before the person who gave the drawings had had an opportunity of knowing any thing whatever of the French form of construction."

IMPROVEMENT IN THE CONSTRUCTION OF ORGANS.

Hitherto, every note in the organ has demanded a separate pipe; and some pipes are as long as thirty-two feet, with bulk in proportion. Thus every additional bass octave or stop, desirable for increase of dignity or grandeur of effect, has involved great space in the sound-board, and much expense. Reflecting upon this restraint to all the variety of harmonious expression which one pair of hands might otherwise produce, Mr. E. Hodges, an organist of Bristol, (an equally restless inquirer in mechanics as in sweet sounds,) conceived that, like the flute, one tube, of whatever large capacity, might possibly be the vehicle of at least five, six, or seven additional notes or tones; and having made the experiment on a small scale, he communinated the result to an ingenious organ-builder, Mr. Smith, whose first public application of the principle was made by the addition of two notes to one of the largest pipes in the organ of St. Mary Redcliffe, Bristol. The whole of that already stupendous monument is now about to receive the benefit of Mr. Hodge's discovery; and Mr. Smith's operative brethren throughout the musical world will doubtless freely share in the gains; for these gentlemen have severally declared themselves indisposed to procure the privilege of a Royal patent.

A BRIEF ACCOUNT OF THE TEA PLANT.

Tea is the leaf of a shrub which grows in several provinces of China, Siam, and Japan. It is planted in rows, and pruned to prevent luxuriancy. "Vast tracts of hilly land (says Sir G. Staunton) are planted with it, particularly in the province of Tochen. Its perpendicular growth is impeded for the convenience of collecting its leaves, which is done first in the spring, and twice afterwards in the course of the summer. Its long and tender branches spring up almost from the root, without any intervening naked trunk. It is bushy like a rose-tree, and the expanded petals of the flower bear some resemblance to that of the rose.

"The tea shrub must have reached three years' growth before the leaves are fit to be plucked, which it then bears in plenty, and very good ones. In seven years it rises to a man's height; but as it grows but slowly, and bears but few leaves, it is

cut down quite to the stem, the leaves it bore having been previously gathered. The next year many young twigs and branches grow out of the remaining stem, which bear leaves in such abundance, as to amply compensate for the loss of the former shrub. Some defer cutting them down till they are ten years old.

"No particular gardens or grounds were formerly allotted for this plant; it was cultivated round the borders of the fields, without any regard to the soil; but it has since become so important a branch of Chinese commerce, that they have formed regular plantations of it in various parts of their extensive empire. The soil selected is generally of a strong quality, which requires little or no preparation.

"When the tea plant has reached the growth of three years, the leaves are collected very carefully one by one, lest they should be torn. The first gathering (which is called Ficki Tsjua, or powdered tea, because the Japanese grind it to powder, and dip it in hot water) begins in the middle of the first moon, immediately before the vernal equinox. These leaves are not fully opened, being only two or three days old; they are called the flower of the tea, and fetch the best price.

"The second gathering, called Tootsja, or Chinese tea, because it is infused and drank in the Chinese manner, begins about a month after the first; it is often sold for the first, especially by those who carefully pick it up, and separate the smallest and tenderest leaves. The third and last gathering, called Bau Tsjaa, is in June, the leaves are sorted into three different classes, according to their quality. It is said that the greatest quantity imported into Europe, is of the third or grossest sort, and of this the natives in general drink.

"The first process is that of making holes in the ground at short distances from each other, in a straight line; this is done by labourers with an implement for the purpose, having a long handle, and sharp pointed head. After the ground is prepared, another class of labourers are employed in sowing the seed. This is done by putting a few of the seeds, varying in number from six to twelve, into each of the holes, which are generally four or five inches deep in the ground, they are then watered and vegetate with little farther care.

"The tea leaves, when gathered, are prepared in Tsiùsi, as they are termed, that is, public drying houses or laboratories, built for the purpose, and where every person may bring leaves to be dried. There are, in these public laboratories, 1st, Several ovens, sometimes as many as twenty, each of which is three feet high, with a wide, flat, square or round iron pan at the top; the side, over the mouth of the oven, is bent upwards, for the person who attends the drying, who stands on the opposite side secure from the fire, and turns the leaves.—2nd, One or more low but very long tables, covered with fine reed mats, on which the leaves are to be rolled.—3rd, A number of workmen, some of whom are employed in attending the drying of the leaves by the oven, and others sitting cross-legged by the tables, to roll the leaves as they come hot from the pan. Sir G. Staunton, in his description, says,—"young women are employed in rolling the leaves."—The leaves must be dried when fresh, and they are generally brought to the laboratory the same day they are gathered. The process of drying is thus performed:—Some pounds of the leaves are put into the iron pan, which, by the fire underneath, has already been heated to a degree, that the leaves when they are put in may crackle at the edges of the pan. The fire in the oven must also be so regulated, that the man attending the drying pan may be able to stir up the leaves with his hands, which he continues to do till they become so hot, that he cannot handle them any longer; the instant they become so, he takes them out of the pan with a shovel, broad at the mouth like a fan, and pours them upon the mat in order that they may be rolled.

"It may be here necessary to relate a very common prejudice already noticed, viz. that the leaves of tea

are dried on copper plates, and consequently must be in some degree poisonous, for chemistry has now ascertained, beyond the possibility of a doubt, that no materials but iron and earthenware are used for the drying of tea; and that were it tinctured with the slightest particle of copper, it would easily be detected by the chemical experiments that have been made on it.

"The method of preparing the leaves of tea is nearly the same, both by the Japanese and Chinese, the only difference appearing to be, that the latter expose the leaves to the steam of boiling water, or put them in soft water for half a minute, a process not observed by the Japanese. Each person takes before him a quantity of the leaves, and whilst they are hot, immediately commences rolling them with the palms of his hands until they are cold, by which means they are equally curled. They then undergo a second drying very slowly and deliberately, for fear of breaking the curls. After this they are again delivered to the rollers, and if the leaves are not fully dry, the process of drying and rolling is repeated a third time. Great care is taken in the second and third drying, that the heat of the fire be lessened in proportion as the leaves have lost their juices and humidity, or they would be burnt or turned black.

"For the more valuable teas, the process of drying and rolling is repeated four or five, or even seven times, thus drying the leaves more gradually, by which means they preserve that lively and agreeable green colour which distinguishes the best teas. The pans are always washed clean with hot water between each drying, because a sharp juice sticks to the edge and bottom of the pan, which is apt to discolour the leaves. The leaves are next spread on the floor, or on tables covered with mats, and are sorted into classes, by which the grosser leaves, and such as are not well curled or too much burnt, are separated from the rest. The dust and smaller leaves are also separated by means of sieves. It may be necessary to observe, that the above description more particularly refers to green teas, not so much care being taken in curling and preserving the colour of black teas. The leaves of Ficki tea are dried to a much higher degree, as it is always used in powder, and some of these leaves, which are very young and tender, are put into hot water, and then laid on thick paper, and so dried without being curled at all. When the tea has been dried, it is packed in earthen vessels or baskets; and after it has been kept some months in these, it is taken out and again dried over a very gentle fire, to deprive it of all its humidity. It is preserved from the air in earthen or porcelain vessels, until it is packed into boxes lined with lead, covered with a species of fine tissue paper, in which manner it is exported. The Chinese preserve the finest sorts of teas in coned vessels made of tutenague, tin, or lead, covered with neat matting of bamboo, until intended for exportation.

"The Chinese infuse their tea in boiling water as we do, and it is said, that when they have drawn off the proper quantity, they prepare the leaves with sugar, oil, and vinegar, for an evening sallad! The Japanese reduce their tea to a fine powder, which they dilute with warm water, until it has acquired the consistence of their soup; this makes the tea of a more rough, earthy, and disagreeable taste. Their manner of serving it is curious, they place before the company the tea equipage, and a box in which a quantity of finely powdered tea is contained; the cups are then filled with warm water, and taking as much powder as will lay on the point of a knife, they throw it into each of the cups, and stir it till the liquor begins to foam; it is then presented to the company, who sip it while it is warm; this custom also prevails in some parts of China. Tea does not appear to have been introduced into Europe until the year 1606, when the Dutch imported a quantity, for which they exchanged dried sage with the Chinese, who were very fond of it, and called it the wonderful European herb, attributing to it numerous virtues; the rate of barter was four

pounds of tea for one pound of sage. (Guthrie in his Grammar of Geography, asserts that the Portuguese were the first who introduced it into Europe.) For such as they could not get in exchange, they purchased at 8d. or 10d. per pound, and on bringing it home, they readily sold it in Paris for 30 livres, and some as high as 100 livres per pound. It was introduced in this country before the restoration, as mention is made of it in the first act of Parliament that settled the excise on the King for life in 1660. Catherine of Lisbon, wife of Charles the 2nd, rendered the use of it common at his court.

FRENCH ROYAL ACADEMY OF SCIENCES.

The Section of Surgery of the Royal Academy of Medicine of Paris, which now fills the place of the Academy of Surgery, held its annual public sitting on Thursday the 20th. Baron Portal, perpetual Honorary President of the Academy, presided, and attracted a very numerous auditory. M. Richerand, Secretary of the Section, pronounced an able discourse on the progress made by Surgery within the last thirty years, and several papers were read: among the rest a very interesting Memoir, by Professor Roux, on the Suture of the *Velum Palatinum*, a most ingenious operation, invented a few years ago by that skilful surgeon, and which he has already put in practice twelve times. The object of this operation is to restore the free use of speech to those who are deprived of it by the division of the *velum palatinum*, a vice in conformation of the inside of the mouth, which is almost as common as the *labia leporina*, or hard lip. This invention is one of the most important and useful that has been made in surgery within a considerable time; and the reading of the Memoir excited the general applause of the meeting.

VARNISH.

SIR,—A correspondent has requested to be informed how to make and use varnish. For oil painting the mastic varnish is the only proper varnish, as it may at any future time be got off from the picture, by a rag moistened with spirits of turpentine. This varnish to be laid on with a hog's hair brush. For prints, drawings, maps, plans, &c. the best white spirit varnish should be used, and laid on at about half a yard from the fire, and with a flat camel's hair brush. The prints, &c. should first have two or three coats of isinglass or leather size, to prevent the varnish from sinking in. For furniture, painted woods, &c. different kinds of varnish are used. As to the making of varnish, it is often attended with uncertainty and risk in the hands of the regular manufacturer, and I advise the inexperienued not to attempt it; but if they will, most particularly to avoid placing any mixture over the fire containing spirits of turpentine, or spirits of wine—many dreadful accidents have happened therefrom: and unless the quantity required be very considerable, it can never answer the purpose of any one to make varnish.

THE HUMAN VOICE.

SIR,—Such different views have been taken of the mechanism of the human voice, that it is by no means easy to reconcile them. Galen, the Greek physician, compared it to a flute, supposing it to be of the nature of a wind instrument. Ferrein and others, on the contrary, have compared it to a violin. Kratzenstein thought it was like a drum with its head divided, and perhaps we shall come nearer the truth by combining those opinions and comparing it with Blumenbach, to an Eolian harp—a stringed instrument played upon by the wind. Our comparison will be still nearer the truth, if with M. Majendie, we refer to those instruments whose sound is produced by a reed such as the hautboy, the pipe, and the clarinet. There is this remarkable difference, however, that the various tones of the voice are produced, not by stopping holes at different distances, as in those reed instruments, but in varying the width of the wind pipe,

at its orifice, or outgoing, where the organ of voice is situated.

The orifice of the windpipe, or organ of the voice, is only about a tenth of an inch at its greatest stretch, viz. when uttering a bass note, and it is capable, in most voices, of about sixty variations in width. These must, consequently, be all confined within this small opening of the tenth of an inch. Dodart therefore may justly say, that the variation of the fiftieth part of a silk worm's thread, or of the three hundredth part of a hair in the diameter of the orifice will occasion a perceptible difference of tone. The motions of the organs in speaking or singing may be easily felt externally, by placing the finger on the fore part of the throat. In this way it is discovered that the organ is drawn farther up, and more forward in producing a shrill tone, and to assist the muscles the head is inclined more backwards than in producing a grave tone. The lowering or raising of the organ is thus ascertained by the finger to be an inch for every octave. The edge of the orifice is composed then of such materials as vibrate like the reed of a hautboy, when the air is thrown forcibly up from the lungs. This apparatus is enclosed in a little box made of gristle, and having moveable sides. This box is called Adam's apple, and is very small in females, and those who have a weak voice. As it is lowered or raised the sides of it are drawn farther asunder, or brought closer together, and consequently the 'reeds,' as we may call them, are either stretched or relaxed, as the tone may require. In singing or speaking at a high pitch of voice the orifice is therefore much narrowed: and as this obstructs the air from passing out of the lungs, it affords an explanation of the great heat in that case produced, according to the theory that animal heat proceeds from breathing.

J. H. B.

OF THE AIR GUN.

The first account we meet with of an air-gun is in the "*Elémens d' Artillerie*" of David Rivant, who was preceptor to Louis XIII. of France: he ascribes the invention to Marin of Lisieu, who presented one to Henry IV. Instruments of this kind, were, however, not wholly unknown to the ancients.

The elasticity of condensed air has been estimated by Mr. Robins as equal to about 1000 times that of common air: admitting, therefore, this to be correct, (although there seems to be great reason to suppose it to be much underrated,) it would be necessary that air should be condensed 1000 times more than in its natural state, to produce the same effect as gunpowder. There is, however, this important consideration to be attended to, viz. that the velocities with which equal balls are impelled, are directly proportional to the square roots of the forces; so that if the air in an air gun be condensed only 10 times, the velocity with which it will project a ball will be 1-10th of that arising from gunpowder; and if the air were condensed 20 times, it would communicate a velocity of 1-7th of that of gunpowder; and so on.

Air guns, however, project their balls with a much greater proportion of velocity than that stated above, and for this reason; that, as the reservoir, or magzine of condensed air, is commonly very large, in proportion to the tube which contains the ball, its density is very little altered by expanding through that narrow tube, and, consequently, the ball is urged all the way by nearly the same uniform force as at the first instant; whereas the elastic fluid arising from inflamed gunpowder is but very small in proportion to the tube or barrel of the gun, occupying, indeed, but a very small portion of it next the butt-end; and therefore, by dilating into a comparatively large space as it urges the ball along the barrel, its elastic force is proportionally weakened, and it acts always less and less on the ball in the tube. Whence it happens that air condensed into a pretty large machine only ten times, will project its ball with a velocity but little inferior to that given by gunpowder; and, if the valve of communication be suddenly shut again by a spring, after opening it to let some air escape, then the same charge may serve to impel several balls in succession. In all cases where a considerable force is required, and, consequently, a great condensation of air, it will be requisite to have the condensing syringe of a small bore, perhaps not more than half an inch in diameter; otherwise the force requisite to produce the compression will become so great, that the operator cannot work the machine; for, as the pressure

against every square inch is about 15lbs., and against every circular area of an inch diameter 12lbs.; if the syringe be an inch in diameter, it will require a force of as many times 12lbs. as the density of the air in the receiver exceeds that of the common atmosphere; so that when the condensation is 10 times, the force required will be 120lbs.; whereas, with a half-inch bore, it will only amount to 30lbs.

DR. CLARKE'S DESCENT INTO THE MINES OF PERSBERG.

The author's visit to these mines was made after he had personally inspected many of the principal works of the same nature in other countries, and especially in his own. For the last ten years of his life, he had been much in the habit of seeing similar works; it is not, therefore, owing to any surprise at the novelty of the scene before him, that he has now to mention the astonishment he felt when he arrived at the mouth of one of the great Persberg mines; but he is fully prepared to say of it, and with truth, there is nothing like it in all that he has beheld elsewhere. For grandeur of effect, filling the mind of the spectator with a degree of wonder which amounts to awe, there is no place where human labour is exhibited under circumstances so tremendously striking.

As we drew near the wide and open abyss, a vast and sudden prospect of yawning caverns, and of prodigious machinery, prepared us for the descent. We approached the edge of the dreadful gulf whence the ore is raised, and ventured to look down, standing upon the verge of a sort of platform, constructed over it in such a manner, as to command a view into the great opening, as far as the eye could reach amidst its gloomy depths; for to the sight it is bottomless. Immense buckets, suspended by rattling chains, were passing up and down; and we could perceive ladders scaling all the inward precipices, upon which the work people, reduced by their distance to pigmies in size, were ascending and descending. Far below the utmost of these figures, a deep and gaping gulf, the mouth of the lowermost pits, was, by its darkness, rendered impervious to view. From the spot where we stood, down to the place where the buckets are filled, the distance might be about seventy-five fathoms; and, as soon as any of these buckets emerged from the gloomy cavity we have mentioned, or until they entered it in their descent, they were visible; but beyond this point they were hid in darkness.

The clanking of chains, the groaning of the pumps, the hallooing of the miners, the creaking of the blocks and wheels, the trampling of horses, the beating of the hammers, and the loud and frequent subterraneous thunder from the blasting of the rocks by gunpowder,—in the midst of all this scene of excavation and uproar, produced an effect which no stranger can behold unmoved; we descended, with two miners and our interpreter, into this abyss. The ladders, instead of being placed like those in our *Cornish* mines, upon a series of platforms, as so many landing-places, are lashed together in one unbroken line, extending many fathoms, and being warped so as to suit the inclination or curvature of the sides of the precipices: they are not always perpendicular, but hang ever in such a manner that, even if a person held fast by his hands, if his feet should happen to slip, they would fly off from the rock and leave him suspended over the gulf; yet such ladders are the only means of access to the works below, —and as the labourers are not accustomed to receive strangers, they neither use the precautions, nor offer the assistance, usually afforded in more frequented mines. In the principal *tin* mines of *Cornwall*, the staves of the ladders are alternate bars of wood and iron—here they were of wood only, and in some parts rotten and broken, making us often wish, during our descent, that we had never undertaken an exploit so hazardous. In addition to the danger to be apprehended from the damaged state of the ladders, the staves were covered with ice or mud; and thus rendered so cold and slippery, that we could have no dependance upon our benumbed fingers, if our feet failed us. Then, to complete our apprehensions, as we mentioned this to the miners, they said,—"Have a care! It was just so," talking about the staves, "that one of our women fell, about four years ago, as she was descending to her work." "Fell!" said our Swedish interpreter, rather simply; "and pray what became of her?" "*Became of her!*" continued the foremost of our guides, disengaging one of his hands from the ladder, and slapping it against his thigh, as if to illustrate the manner of the catastrophe,—"*she became* (pantaka) *a pancake.*"

As we descended farther from the surface, large masses of ice appeared, covering the sides of the precipices. Ice is raised in the buckets with the ore and rubble of the mine; it was also accumu-

lated in such quantity in some of the lower chambers, that there are places where it is fifteen fathoms thick, and no change of temperature above prevents its increase.

This seems to militate against a notion now becoming prevalent, that the temperature of the air in mines increases directly as the depth from the surface, owing to the increasing temperature of the earth under the same circumstances and in the same ratio; but it is explained by the width of the aperture at the mouth of the mine, which admits a free passage of atmospheric air. In our *Cornish* mines, ice would not be preserved in a solid state at any considerable depth from the surface.

After much fatigue, and no small share of apprehension, we at length reached the bottom of the mine. Here we had no sooner arrived, than our conductors, taking each of us by an arm, hurried us along, through regions of "thick ribbed ice" and darkness, into a vaulted level, through which we were to pass into the principal chamber of the mine. The noise of the countless hammers, all in vehement action, increased as we crept along this level; until at length, subduing every other sound, we could no longer hear each other speak, notwithstanding our utmost efforts. At this moment we were ushered into a prodigious cavern, whence the sound proceeded; and here, amidst falling waters, tumbling rocks, steam, ice, and gunpowder, about fifty miners were in the very height of their employment. The magnitude of the cavern, over all parts of which their labours were going on, was alone sufficient to prove that the iron ore is not deposited in veins, but in beds:—above, below, on every side, and in every nook of this fearful dungeon, glimmering tapers disclosed the grim and anxious countenances of the miners. They were now driving bolts of iron into the rocks, to bore cavities for the gunpowder, for blasting. Scarcely had we recovered from the stupefaction occasioned by our first introduction into this *Pandemonium*, when we beheld, close to us, hags more horrible than perhaps it is possible for any other female figures to exhibit, holding their dim quivering tapers to our faces, and bellowing in our ears. One of the same sisterhood, snatching a lighted splinter of deal, darted to the spot where we stood, with eyes inflamed and distilling rheum,—her hair clotted with mud; dugs naked and pendulous; and such a face, and such hideous yells, as it is impossible to describe.

"Black it stood as night,—fierce as ten furies,—
Terrible as hell!"

ON THE MANNER OF PREPARING THE ELASTIC COMPOSITION ROLLERS OR CYLINDERS, WHICH ARE EMPLOYED TO DISTRIBUTE INK OVER THE SURFACE OF THE TYPES IN PRINTING MACHINES.

In the first place, the metal axis of the intended roller is to be formed as true as possible, by turning it in a lathe; after which a metallic cylinder is firmly fixed upon the said axis, being in diameter about two or three inches less than the composition roller is intended to be when completed. The metallic cylinder is then covered entirely with canvass or other coarse cloth, secured upon the same by sewing, which precaution is necessary for the purpose of causing the elastic composition to adhere firmly to its surface. In this state the axis and its cylinder, covered with canvass, are placed perpendicularly in a mould formed of pewter, being correctly bored and polished interiorly to the exact diameter which the elastic roller should be when finished; the canvass cylinder being retained steadily in the centre of the mould by means of two end plates, which enter a short distance into the ends of the mould, having holes through them of the exact size to receive the pivots of its axis, in the same manner as is practised in the casting of lead pipes. The interior surface of the mould should be rubbed with grease, and being thus prepared, is ready to receive the fluid composition, which is composed of the admixture of common glue (previously soaked in water) and treacle, melted together in an iron pot over a slow fire. The proportions of these ingredients vary so much in consequence of the different qualities of the materials employed, that the best guide is to mix a small quantity first, and when melted pour it upon a cold smooth surface, when its quality and fitness for use will be easily ascertained by the pressure of the finger to try its hardness and elasticity. When the composition is properly proportioned and melted, it must be poured into the mould (through a hole which is formed for the purpose in one of the end plates,) until the entire cavity round the

canvass cylinder be filled. As soon as the composition is cooled or set, one of the end plates of the mould is to be removed, and the axis (to which the coating of composition should adhere firmly) is to be carefully drawn out, when, if the operation has been properly conducted, the roller will be found to possess a fine, smooth, and polished surface, ready for use. The composition is of such a nature as not to be affected by the oil of the printing ink; and to prevent their surfaces growing hard, when not in use they should be kept in a damp place.

ON MELTING STEEL WITH SILVER.

If steel and silver be kept melted together for a length of time, a meltal is obtained which appears very perfect while the two metals are in a melted state; but, as they fix, little balls of silver are squeezed from the mass, and appear on the surface of the button.

When the mixed metal is forged into a bar, and kept for some time in water soured with oil of vitriol, to eat away the steel, the silver appears in threads dispersed among the metal, so that the whole has the appearance as if silver and steel had been united by welding. Messrs. Faraday and Stodart observes, that the appearance of these silver fibres is very beautiful,—they are sometimes an eighth of an inch long, and suggest the idea of giving a mechanical toughness to steel, when a very perfect edge may not be required.

One part of silver melted with 160 of steel, were always fibrous, and sweated small balls of silver on cooling, and more when forged; in a moist air the mixed metal rusted very quickly.

One part of silver melted with 200 of steel, still gave a fibrous metal, which sweated balls of silver.

One part of silver melted with 300 of steel, gave a button in which fibres of silver were still to be seen; and they were detected even when one part of silver was melted with 400 of steel.

One part of silver melted with 500 of steel, produced a metallic button, on which no balls of silver could be seen; and when forged and acted upon by water soured with oil of vitriol, no fibres could be discovered in its grain, even by a good microscope. It forged remarkably well, although very hard, and was decidedly superior to the very best steel; cutting instruments of the very best quality have been made from it.

ON RAISING ROOFS.

A cotton-mill, thirty yards long by ten wide, situated at Golt Stook, near Bingley, in Yorkshire, the property of Mr. J. G. Horsefall, of that place, has, within this fortnight, been raised a story, by the use of the hydraulic press, without disturbing the roof or displacing any of the machinery. This operation was performed by placing the pump under the rafters in succession, and working the piston, when the roof is seen to rise about eight inches at a time, and stones of the requisite dimensions are introduced in succession, till a course of stones is placed all round the mill: the pump is then again applied in the same manner as before, and other stones placed, till at length the story is completed, and the additional room gained, without affecting the stability of the edifice.

The saving of expense by this mode of elevating a building is considerable; and in the present case it is calculated at from 80*l.* to 90*l.* The weight of the roof and timbers could not be less than 80 tons, the room gained is 10 feet high, and not a single slate has been broken.

Leeds Mercury.

ON THE ORIGIN OF THE BATSWING GAS BURNER.

This excellent method of producing a large light with a small expenditure of gas, was discovered by accident, and shows the small means from which the greatest improvements often arise. A brass founder, who wished to exhibit to a friend the production of gas on a small scale, when it first came into use, had at hand only a burner, whose hole had accidentally been stopped up; and not having any instrument at the time to unstop it, he in haste took hold of a saw which lay by him, and made a cross cut through the hole. When this was tried, he found, to his great joy, that it produced the most brilliant effect; and being a collector of animals, he instantly compared it to the wing of a bat, which name the burner has kept ever since. His friends were anxious he should secure an interest in it by a patent, but he generously gave it to the trade at large.

ON ENGLISH TAPIOCA.

The Portuguese tapioca is a starchy, mucilaginous substance, in small white lumps, prepared from the root of the jatropha manihot. It differs from arrow-root by not easily dissolving in water.

English tapioca, exactly similar to that of the Brazils, may be made by grating potatoes into water, straining the liquor into a clean pan, aud letting it stand to settle. The water being then poured off, and the remaining moist potatoe starch heated, it forms a clear mucilage, which breaks by stirring into various sized lumps; and these being dried in a gentle heat, form a tapioca which cannot be distinguished from the foreign,—requiring, like it, long boilng in water or milk to soften the lumps.

EXAMINATION OF PALLADIUM.

Mr. Breant, having had placed at his disposal all the platina in the possession of the Spanish government, being no less than twenty hundred weight, obtained from it a quantity of palladium, which enabled him to examine its properties on a large scale.

Palladium has the colour of silver, and is equally workable: it is twelve times as heavy as water, bulk for bulk, and, of course, about one-sixth part heavier than silver itself. It is melted with great difficulty, and requires as great a heat as iron. It is not subject either to tarnish in the air, or rust by moisture. At a dull red heat it takes a reddish violet tinge; but at a greater heat it again acquires its shining metallic appearance.

This metal dissolves in a mixture of aqua fortis and spirit of salt; without the necessity of heating the liquid. It unites easily with other metals, and the alloys are generally workable. Gold united with it, even in very small quantity, entirely loses its yellow colour.

From these qualities it appears, that if this metal was more common, it would be preferrable, for certain purposes, to silver; but, unfortunately, it is at present so rare, as to be six times the value of gold.

METHOD OF CLEANING AND POLISHING STEEL.

After well oiling the rusty parts of the steel, let it remain two or three days in that state; then wipe it dry with clean rags and polish with emery or pumice stone, on hard wood. Frequently however, a little unslacked lime finely powdered will be sufficient, after the oil is cleared off.—Where a very high degree of polish is requisite, it will be most effectually obtained by using a paste composed of finely levigated blood stone and spirits of wine. Bright bars are, however, admirably cleaned in a few minutes, by using a small portion of corn emery, and afterwards finishing with flour of emery or rotten stone; all of which may be obtained at any ironmonger's or oil shop. This last very simple method will render any other superfluous.

ON PUDDLING IRON.

Mr. Watford having observed in that department of the manufacture of iron called *puddling*, the cast iron bottoms of the floors usually employed rapidly decay, and that the iron, clay, scoria, or sand, used to defend them from injury, impart impurities to the iron, he has adopted and secured by patent, the following simple and effectual mode of rendering them durable:—He spreads over the cast iron bottoms a quantity of charcoal reduced to powder, which, being a bad conductor of heat, protects the cast iron floors better than any other substance, from the intense heat which is required in the furnaces, and greatly improves the quality of the iron.

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